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fessor Hubrecht finds mathematics unconvincing, we would beg him to consult genealogical records, by which he could ascertain the carefully registered contradiction of his assumption that there is a series of the first-born, or even an approximation to it.

Second, We cannot accept the assertion, that a large number of ancestors increases the tendency to variability, because the direct influence of the progenitors upon the production of variations very rapidly diminishes as the number of generations increases. And, on the other hand, it is well known that long-inherited characteristics are the most constant. The more ancient a feature is, the greater its fixity: hence we might as well assume the opposite of Hubrecht's assertion; viz., that the greater the number of ancestors, the more fixed the qualities of the young. Here it may be noticed, that although it is very probable that the parents' age causes modifications in the young, yet Hubrecht mentions only one fact to support the assertion, and that fact is the only one brought forward to support any portion of his hypotheses. We certainly have no sufficient reason for agreeing with the assumption that first-born would be more variable than last-born.

Third, If we admit the two previous premises, we should still have to show that they have given us the determination of the real causes. If evolution by primogeniture were a real cause, then the most variable animals, or those classes where there are most species, would, in consequence of inherited habit, produce young while themselves young, and the stable types would have acquired the characteristics of reproducing very late. Such, however, is not the case. Insects, the most variable of types, reproduce, for the most part, at the end of their lives; while the permanent type, Lingula, reproduces while young. Further objections might be added; but sufficient has been said to explain, and, it is believed, to justify, the condemnation of the hypotheses involved in the author's generalization.

Professor Hubrecht, by his able morphological researches on various subjects, notably on the anatomy of nemertines, has earned a well-deserved esteem: and it is a matter of regret to have to criticise any writing of his severely; but the tendency to draw a maximum of conclusion from a minimum of fact is one to which we feel impelled to object most strenuously. Hubrecht (p. 279) speaks almost sneeringly of what he is pleased to call the school of scientific zoölogists,[1] or those who have sought to elevate zoölogy above mere systematic work. The cause of his *animus* we do not know, but feel that he is hardly just, and not likely to wish to be called an *unscientific* zoölogist himself. Of his hypothesis of development by primogeniture, our opinion has been expressed.

CHARLES S. MINOT.

NOTES ON THE GEOLOGY OF JAPAN.

WE are permitted, by the courtesy of M. Jules Marcou of Cambridge, to make use of the following extract from a letter addressed to him from Tokio by Dr. C. Gottsche, professor of geology in the Tokio *daigaku*, or imperial university.

Since you published, seven years ago, the *Explication d'une carte géologique de la terre*, much has been changed in Japan. Lyman's flying surveys in Yesso and Japan expired in 1879. A new geological survey has been established, under the superintendence of Dr. E. Naumann; geology has been taught for more than six years, both in the university and at the engineering college of Tokio; and travellers are allowed to cross the interior in every direction. A mass of information has been procured in this way; and I suppose you will find valuable materials in the notices, and in the little sketch-map my friend and countryman, Dr. Naumann, is just preparing for you. Nevertheless, I take the liberty to furnish you with some additional remarks on facts or specimens which I have recently examined, and which might be overlooked by him.

The upper Devonian system is indicated by half a dozen specimens of Spirifer disjunctus de Verneuil, which I met in several old Japanese collections, and which partly originate from the provinces Tosa (on Shikoku) and Ise (on the main island). This fossil has not yet been met with *in situ*.

The carboniferous system is only represented by marine limestones, which are exposed in seventeen localities along the eastern coast of Japan, from 39° 10′ N. L. to 31° 20′ N. L. The fauna is very scanty; but everywhere the limestones are characterized by the common occurrence of Fusulina and Schwagerina, which in many cases are accompanied by Endothyra, Textilaria, and Trochammina. Among other fossils, I mention only Bellerophon (?) hiulcus Sow., Favosites, and Poteriocrinus.

The limestones correspond, in my judgment, to the whole carboniferous system, the upper productive series included. My reasons are: 1°. The different paleontological character of the lower carboniferous mountain-limestone of Lo-ping in China (cf. Kayser, *Zeitschr. deutsch. geol. gesellsch.*, 1881, 351); 2°. The common occurrence of the genus Schwagerina, which I think is confined to the uppermost carboniferous and lower dyassic systems of Nebraska, Russia, and Austrian Alps; 3°. The researches of V. von Möller, who states that the marine carboniferous limestones of Russia also represent the entire system. From the second point, it might seem that our Japanese deposits correspond only to the uppermost series, which in China is really productive.

The dark triassic shales, with Monotis salinaria, var. Richemondiana Zittel, which Dr. Naumann discovered near Sendai (*Jahrb. k.-k. reichsanst.*, 1881, 519), now extend from 40° N. L. (Niageba, province of Ugo) to 33° N. L. (Kinkaisan, province of Higo). This will be the more interesting to you as special care is devoted in your Explication to the Monotis strata. Very similar dark shales from Okatzumura and Minatomura, district of Ojikagori, province of Rikuzen (about 38° 30′ N. L., 141° 20′ E. long., Greenw.), are lower liassic. I recognized within them Arietites bisulcatus Brug., Arietites of rotiformis Sow., and Lytoceras sp. of the group of L. fimbriatum. The two Arietites are characteristic for the Ammonites Bucklandi-zone of Oppel.

The middle Jurassic is only represented by plant-bearing shales. Dr. Geyler of Frankfurt described already sixteen species from the Tetorigawa valley, in the province of Kaga (*Palaeontogr.*, xxiv. 221, 5 pl.), mostly identical with Jurassic species from Amuria, eastern Siberia, and Spitzberg. In the mean while the number of localities and fossils has somewhat increased. The said strata have been met with again at Nozirimura, province of Echizen; Ogamigo, district of Onogori, province of Hida; Midzutani, near Yuasa, province of Kishiu; and Tannomura, province of Awa, on Shikoku. The leading fossil is everywhere Podozamites lanceolatus

[1] Scientific zoölogy (*wissenschaftliche zoologie*) has had, since the establishment of Siebold and Kölliker's *Zeitschrift für wissenschaftliche zoologie*, a special significance to professional naturalists.

Lindl. sp., and P. Reinii Geyl. The fresh-water or brackish character of these deposits is proved by the occurrence of true and undoubted Cyrena sp. and Estheria.

The cretaceous fossils of Yesso are carefully examined by Naumann (*Mitth. deutsch. ostasiat. gesellsch.*, heft 21), and partly (thirteen species) identified with Indian types, partly with shells described by Schmidt, from Sachalin. His result is, that the Ammonite-beds of Yesso are upper-cretaceous, and correspond especially to the Ootatoor-group of India.

During the last vacation, I got, from Shikoku, sandstones which are also upper cretaceous. They are quite filled with a Trigonia of the scabra-group, probably T. aliformis Park. Two other Trigoniae, which I cannot determine with the literature at hand, fragments of Natica and Hamites, accompany it. The said sandstones have been met with at Oruno, district of Itanagori, province of Awa; Tannomura, district of Katsuragori, province of Awa; Yassudamura, district of Akigori, province of Tosa, — on the island of Shikoku.

The tertiary strata are rather thick. Those which have been studied by Dr. Brauns (*Mem. Tokio univ.*, no. 4, 1881) and A. Nathorst (*Svensk. akad. handl.*, 1882) are pliocene, most of the shells and plants described being identical with living ones. Miocene, or older strata, are not yet recognized with certainty.

Glacial phenomena have not left any traces in Japan.[1] I conclude here with the remark that the list of your *Explication* contains some volcanoes (nos. 8 and 9, p. 114; nos. 4 and 10, p. 115) which I cannot make out. More complete are the lists of Naumann (Yokohama, 1878) and Milne (*Trans. seismol. soc. Japan*, iv. 1882): but even these are not complete; for a recent revision I made gave forty-eight volcanoes which are active now, or have been active within historical time, or are still in the solfatara state. Besides that, I know about forty cones which are probably prior to human record, and date back as far as the pliocene series, which is very often tufaceous or filled with pumice-fragments.

PERFECT INTERFERENCE OF SOUND BY TELEPHONE.

SUPPOSE we have two telephones having the poles of their magnets similarly placed, and so connected with a circuit that a current will traverse their coils in the same direction. It is evident that any electric current passing will cause a simultaneous movement in the same direction in the diaphragms of both telephones. Now, if we conceive the current reversed in one of the telephones, the motions will have opposite signs. It follows, then, that the currents due to the vibration of the diaphragm of a third telephone in the circuit will produce in the two telephones vibrations of *opposite phases;* the sounds produced, therefore, will differ by a half-wave length. The same current which in one telephone produces a condensation will in the other produce a rarefaction.

The experiment, as successfully tried in the physical laboratory of Dartmouth college by Professor Emerson and myself, was arranged as follows: the mouths of two similar telephones were placed before the extremities of a Y-shaped tube, and the sound from both telephones conducted to the ear by rubber tubing. A reversing-switch was placed in the circuit, by means of which the direction of the current in one of the telephones could be changed; in this way could be produced at will coincidence or interference of sound. Each branch of the Y-tube was of rubber, so that either arm could be closed by pinching. Organ-pipes of various lengths were sounded near a telephone in a neighboring building. It was found, that, when arranged for interference, the pinching of either of the branch-pipes produced a very decided increase in the intensity of the sound; when reversed, an equally decided decrease. The inequality in the intensity of the sounds due to the two telephones was found to be the chief difficulty in producing complete interference; but by partly closing one branch, so as to weaken the stronger sound, the effect was much improved. In several trials the interference was complete, no sound whatever being audible. The rapid reversal by the switch gave a sharp contrast between the strengthening and the weakening effect.

This method of demonstrating the phenomenon of interference has obviously the advantage of applicability to sounds of any pitch. With singing, the interference was very satisfactory, especially with the lower notes; in conversation, however, the sound is not so much weakened, but the quality is perceptibly changed. The vowels seemed to suffer much more than the consonants. C. S. COOK.

[1] The writer ignores the discovery of Prof. J. Milne of the engineering school of Tokio, at the large mountain of Gwassan, northern part of Nipon, where are large bowlders and *roches moutonnées*, — the product of glacial action. — J. M.

RAILWAY-ACCIDENTS IN 1882.

THE statistics of railroad operation in this country are far too incomplete and unreliable to admit of drawing any very general conclusions. Certain facts, however, appear with sufficient distinctness to show some very grave defects in the system under which our roads are worked. The *Railroad gazette* publishes monthly and annually a list of accidents to trains while in motion. This, however, does not include over twelve per cent of the whole number of casualties. Again, accidents not resulting in loss of life or in serious damage to property are rarely recorded; though in many cases the blame is not less great, and the lesson conveyed not less important. The total number of train-accidents for the past ten years is returned as below; the second horizontal column showing the actual number, and the third column the number per thousand miles of road in operation: —

1873	1874	1875	1876	1877	1878	1879	1880	1881	1882
1,283	980	1,201	982	891	740	910	1,078	1,458	1,365
18.3	13.6	16.2	12.8	11.3	9.0	10.6	11.6	13.9	12.4

If we regard the second line alone, the figures would seem to be sufficiently discouraging, as there is a steady increase in the number of accidents from 1878 to 1881. We must, however, take into account the growth of the railroad-system. This is done in the third line; and here, again, while we find a somewhat less rate of increase, the fact still remains, that our roads are not growing safer as they expand in extent.

If we examine in detail the causes of accidents, we shall see that they are less dependent upon the total length of roads in operation, than upon the density of the traffic; in accordance with the law, that failures of track and bridges are approximately in proportion to the length of road, while the number of collisions is in proportion to the square of the number of trains.